

What is claimed is:

1. A method of separating fluids successively introduced into a passage comprising the step of introducing a plug at an interface of the successively introduced fluids, wherein the plug comprises an outer body and a detachable inner mandrel attached to the outer body.
2. The method of claim 1, wherein the detachable inner mandrel is held in place within the outer body of the plug by at least one frangible device.
3. The method of claim 2, wherein the at least one frangible device comprises a shear pin, a shear ring, a controlled strength glue joint, or combinations thereof.
4. The method of claim 1 wherein the detachable inner mandrel can be released from the outer body of the plug by applying a differential pressure across the detachable inner mandrel.

5. A method of separating fluids successively introduced into a subterranean well bore, comprising the steps of:

introducing a first fluid into the well bore through a casing string;

introducing a second fluid into the well bore behind the first fluid such that an interface between the two fluids is formed;

suspending an assembly comprising a plurality of plugs within the casing string, wherein at least one of the plugs comprises an outer body and a detachable inner mandrel attached to the outer body; and

deploying the at least one plug within the casing string at the interface of the first and second fluids.

6. The method of claim 5 wherein the step of introducing a second fluid into the well bore occurs after the step of suspending an assembly comprising a plurality of plugs within the casing string.

7. The method of claim 5 wherein the casing string has an inner diameter and the detachable inner mandrel has a length greater than the inner diameter of the casing string.

8. The method of claim 5 wherein the step of deploying at least one of the plugs comprises the steps of: placing a releasing device into the well bore; contacting at least one of the plugs with the releasing device; and causing at least one of the plugs to separate from the assembly.

9. The method of claim 8 wherein the releasing device comprises a free fall device or a positive displacement device.

10. The method of claim 9 wherein the positive displacement device comprises a dart.

11. The method of claim 9 wherein the positive displacement device has a nosepiece, and wherein the nosepiece comprises a unique key profile.

12. The method of claim 9 wherein the positive displacement device has a nosepiece, and wherein the nosepiece comprises a latch-down mechanism.

13. The method of claim 12, wherein the latch-down mechanism is a self-energized "C" ring.

14. The method of claim 8 wherein the plugs are attached to each other by at least one frangible device.

15. The method of claim 5 wherein the at least one plug comprises a unique key profile.

16. The method of claim 5 wherein the at least one plug comprises a latch-down mechanism.

17. The method of claim 14 wherein the at least one frangible device comprises a shear pin, a shear ring, a controlled strength glue joint, or combinations thereof.

18. The method of claim 14 wherein the step of causing at least one of the plugs to separate from the assembly comprises shearing the at least one frangible device.

19. The method of claim 5 further comprising the step of installing a baffle adapter in the casing string, wherein the baffle adapter has an inner bore designed to engage and seal against at least one of the plugs.

20. The method of claim 19 wherein a portion of the inner bore comprises a unique receiving profile such that a plug comprising a matching unique key profile may lock within it.

21. The method of claim 19 wherein a portion of the inner bore is configured to accept a latch-down mechanism on a plug.

22. The method of claim 19 wherein a portion of the inner bore is tapered.

23. The method of claim 19 wherein the baffle adapter comprises a perforated catcher tube.

24. The method of claim 5 further comprising the step of applying a differential pressure across the inner mandrel of the at least one plug, after the step of deploying the at least one plug, thereby causing the inner mandrel to detach from the outer body of the at least one plug.

25. The method of claim 24 further comprising the step of landing the at least one plug atop or against the baffle adapter, and wherein the step of landing the at least one plug is performed before the step of applying a differential pressure.

26. The method of claim 24 further comprising the step of catching the detached inner mandrel in a perforated catcher tube attached to a baffle adapter installed in the casing string.

27. The method of claim 24 further comprising the step of allowing the detached inner mandrel to fall onto a float valve installed in the casing string.

28. The method of claim 24 further comprising the step of allowing the detached inner mandrel to fall onto a bypass baffle installed in the casing string.

29. The method of claim 19 wherein the inner bore has an inner diameter, and wherein the inner diameter is in the range of from about 70% to about 90% of the inner diameter of the casing string.

30. The method of claim 11 wherein the detachable inner mandrel has an inner bore, and wherein the inner bore comprises a unique receiving profile such that a releasing device comprising a matching unique key profile may lock within it.

31. The method of claim 12 wherein the detachable inner mandrel has an inner bore, and wherein the inner bore is configured to accept a latch-down mechanism on a releasing device.

32. The method of claim 21 wherein each of the plurality of plugs comprises a latch-down mechanism, and wherein a float valve is not present within the casing string.

33. The method of claim 32 wherein at least one of the plurality of plugs comprises a receiving portion configured to accept a latch-down mechanism from a leading end of a successive plug.

34. A method of cementing a casing string in a subterranean well bore comprising the steps of:
- injecting a cement composition into the casing string; and
 - deploying within the casing string at least one cementing plug comprising an outer body and a detachable inner mandrel attached to the outer body.
35. The method of claim 34 wherein the casing string has an inner diameter, and wherein the detachable inner mandrel has a length greater than the inner diameter of the casing string.
36. The method of claim 34 further comprising the step of suspending the at least one cementing plug within the casing string prior to deploying the at least one cementing plug within the casing string.
37. The method of claim 34 wherein the at least one cementing plug is attached to a running tool or work string within the casing string, and wherein the step of deploying at least one cementing plug comprises the steps of: placing a releasing device into the well bore; contacting the at least one cementing plug with the releasing device; and causing the at least one cementing plug to separate from the running tool or work string.
38. The method of claim 37 wherein the releasing device comprises a free fall device or a positive displacement device.
39. The method of claim 38 wherein the positive displacement device comprises a dart.
40. The method of claim 38 wherein the positive displacement device has a nosepiece, and wherein the nosepiece comprises a unique key profile.
41. The method of claim 38 wherein the positive displacement device has a nosepiece, and wherein the nosepiece comprises a latch-down mechanism.
42. The method of claim 42 wherein the latch-down mechanism is a self-energized "C" ring.
43. The method of claim 34 wherein the at least one cementing plug comprises a unique key profile.
44. The method of claim 34 wherein the at least one cementing plug comprises a latch-down mechanism.

45. The method of claim 34 wherein the at least one cementing plug comprises at least one frangible device.
46. The method of claim 45 wherein the at least one frangible device comprises a shear pin, a shear ring, a controlled strength glue joint, or combinations thereof.
47. The method of claim 37 wherein the at least one cementing plug comprises at least one frangible device, and wherein the step of causing the at least one cementing plug to separate from the casing string comprises shearing the at least one frangible device.
48. The method of claim 34 further comprising the step of installing a baffle adapter in the casing string, wherein the baffle adapter has an inner bore configured to engage and seal against the at least one cementing plug.
49. The method of claim 48 wherein a portion of the inner bore is tapered.
50. The method of claim 48 wherein a portion of the inner bore comprises a unique receiving profile such that a plug comprising a matching unique key profile may lock within it.
51. The method of claim 48 wherein a portion of the inner bore is configured to accept a latch-down mechanism on a plug.
52. The method of claim 48 wherein the baffle adapter comprises a perforated catcher tube.
53. The method of claim 34 further comprising the step of detaching the detachable inner mandrel from the outer body of the at least one cementing plug.
54. The method of claim 53 wherein the inner mandrel is detached by applying a differential pressure across the inner mandrel.
55. The method of claim 54 further comprising the step of catching the detached inner mandrel in a perforated catcher tube attached to a baffle adapter installed in the casing string.
56. The method of claim 54 further comprising the step of allowing the detached inner mandrel to fall onto a float valve installed in the casing string.
57. The method of claim 54 further comprising the step of allowing the detached inner mandrel to fall onto a bypass baffle installed in the casing string.

58. The method of claim 40 wherein the detachable inner mandrel has an inner bore, and wherein the inner bore comprises a unique receiving profile such that a releasing device comprising a matching unique key profile may lock within it.

59. The method of claim 41 wherein the detachable inner mandrel has an inner bore, and wherein the inner bore is configured to accept a latch-down mechanism on a releasing device.

60. The method of claim 48 wherein the inner bore has an inner diameter, and wherein the inner diameter is in the range of from about 70% to about 90% of the inner diameter of the casing string.

61. The method of claim 48 wherein the baffle adapter is further configured to sealingly latch with the at least one cementing plug, further comprising the steps of:

assembling the casing string without a float valve;

displacing a first of the at least one cementing plugs until it sealingly latches with the baffle adapter; and

displacing any successively deployed plug until it sealingly latches with a previously deployed plug.

62. A method of activating a device in a subterranean well bore, the device comprising a baffle adapter configured to achieve sealing contact with a cementing plug, the cementing plug comprising an outer body and a detachable inner mandrel attached to the outer body, comprising the steps of:

displacing the cementing plug into contact with the baffle adapter so that the outer body of the plug achieves sealing contact with the baffle adapter; and
applying a first differential pressure across the cementing plug, thereby activating the device.

63. The method of claim 62 wherein the device has a length, wherein the device further comprises:

ports disposed along its length; and
an inner sliding sleeve; and

wherein activating the device comprises displacing the inner sliding sleeve to seal off the ports such that fluid is prohibited from flowing through the ports.

64. The method of claim 62 further comprising the step of applying a second differential pressure across the detachable inner mandrel, thereby causing the inner mandrel to detach from the outer body of the cementing plug, wherein the second differential pressure is greater than the first differential pressure.

65. The method of claim 62 wherein the detachable inner mandrel has a length greater than the diameter of the well bore.

66. The method of claim 64 further comprising the step of catching the detached inner mandrel in a perforated catcher tube.

67. The method of claim 62 wherein the cementing plug comprises a latch-down mechanism, and wherein a portion of the baffle adapter comprises a receiving profile configured to accept the latch-down mechanism.

68. The method of claim 64 further comprising the step of restraining the detached inner mandrel with a float valve installed in the casing string.

69. The method of claim 64 further comprising the step of restraining the detached inner mandrel with a bypass baffle installed in the casing string.

70. The method of claim 64 wherein outer body comprises an inner bore, and wherein the detachment of the inner mandrel from the outer body permits fluid flow through the inner bore.

71. The method of claim 62 wherein the plug comprises a unique key profile, and wherein a portion of the baffle adapter comprises a matching unique receiving profile.

72. A plug system for separating fluids successively introduced into a passage comprising:

an assembly comprising a plurality of plugs, wherein at least one plug comprises an outer body and a detachable inner mandrel attached to the outer body; and wherein the plurality of plugs are releasably attached to each other.

73. The plug system of claim 72 wherein the passage has a diameter and the inner mandrel has a length greater than the diameter of the passage.

74. The plug system of claim 72 wherein the inner mandrel is attached to the outer body by at least one frangible device.

75. The plug system of claim 74 wherein the at least one frangible device comprises a shear pin, a shear ring, a controlled strength glue joint, or combinations thereof.

76. The plug system of claim 72 wherein at least one of the plurality of plugs is attached to another of the plurality of plugs by at least one frangible device.

77. The plug system of claim 76 wherein the at least one frangible device comprises a shear pin, a shear ring, a controlled strength glue joint, or combinations thereof.

78. The plug system of claim 72 wherein two adjacent plugs have inner mandrels and wherein the inner mandrels of adjacent plugs shoulder against each other.

79. The plug system of claim 78 wherein at least one of the plurality of plugs is attached to another of the plurality of plugs by at least one frangible device, and wherein the shouldering prevents premature shearing of the at least one frangible device by directing compressive loading through the inner mandrels.

80. The plug system of claim 79 wherein the shouldering occurs at slotted shouldering areas.

81. The plug system of claim 80 wherein such slotted shouldering areas prevents hydraulic sealing of the inner mandrels against each other.

82. The plug system of claim 72 wherein the assembly of plugs comprises a top cementing plug and at least one bottom cementing plug having an inner mandrel.

83. The plug system of claim 82 wherein the top cementing plug comprises an inner sleeve that shoulders against the inner mandrel of the at least one bottom cementing plug.

84. The plug system of claim 82 wherein the top cementing plug comprises a collet release mechanism for disengaging the top cementing plug from a work string.

85. The plug system of claim 72 wherein the assembly of plugs comprises a top cementing plug at one end of the assembly, a first bottom cementing plug at the other end of the assembly, and at least one second bottom cementing plug disposed between the top cementing plug and the first bottom cementing plug, the at least one second bottom cementing plug comprising a detachable inner mandrel, wherein each of the plugs in the assembly has means for sealingly attaching each plug to an adjacent plug, and wherein the sealing means are configured such that on the application of a differential pressure across the plug assembly, the inner mandrel of the at least one second bottom cementing plug is maintained in compression.

86. The plug system of claim 85 wherein the sealing means comprises a first seal between the top cementing plug and the assembly, and a second seal between the at least one second bottom cementing plug and the assembly, wherein each seal has a diameter, and wherein the diameter of the second seal exceeds the diameter of the first seal.

87. The plug system of claim 72 further comprising a baffle adapter having an inner surface adapted to engage at least one of the plurality of plugs.

88. The plug system of claim 87 wherein a portion of the inner surface is tapered.

89. The plug system of claim 87 further comprising a perforated catcher tube attached to the baffle adapter.

90. The plug system of claim 72 wherein one end of at least one plug comprises a face seal arrangement.

91. The plug system of claim 72 wherein one end of at least one plug comprises a nose-seal arrangement.

92. The plug system of claim 91 wherein the nose-seal arrangement comprises a unique key profile.

93. The plug system of claim 91 wherein the nose-seal arrangement further comprises a latch-down mechanism.
94. The plug system of claim 93 wherein the latch-down mechanism is a self-energized "C" ring.
95. The plug system of claim 88 wherein the inner surface has an inner diameter, and wherein the inner diameter of the inner surface is in the range of from about 70% to about 85% of the inner diameter of the casing string.
96. The plug system of claim 72 further comprising a bypass baffle on which to land an inner mandrel from at least one of the plurality of plugs.
97. The plug system of claim 87 wherein a portion of the inner surface comprises a unique receiving profile such that a plug having a matching unique key profile may lock within it.
98. The plug system of claim 87 wherein a portion of the inner surface is configured so as to accept a latch-down mechanism on a plug.
99. The plug system of claim 72 wherein the detachable inner mandrel has an inner bore, and wherein the inner bore is configured to accept a latch-down mechanism on a releasing device.
100. The plug system of claim 72 wherein the detachable inner mandrel has an inner bore, and wherein the inner bore comprises a unique receiving profile such that a releasing device having a matching unique key profile can lock within it.

101. A plug for separating fluids successively introduced into a passage comprising:
- an outer body and
 - a detachable inner mandrel attached to the outer body.
102. The plug of claim 101 wherein the inner mandrel is attached to the outer body by at least one frangible device.
103. The plug of claim 102 wherein the at least one frangible device comprises a shear pin, a shear ring, a controlled strength glue joint, or combinations thereof.
104. The plug of claim 101 further comprising wiper fins attached to the outer body.
105. The plug of claim 104 wherein the wiper fins are foldable.
106. The plug of claim 101 wherein the outer body and the inner mandrel are concentric and the inner mandrel has a portion that extends beyond the outer body, the extended portion having a tapered outer diameter.
107. The plug of claim 106 wherein the extended portion of the inner mandrel further comprises longitudinal slots.
108. The plug of claim 101 wherein one end of the outer body has a tapered outer diameter.
109. The plug of claim 101 wherein one end of the outer body comprises a face seal arrangement.
110. The plug of claim 101 wherein one end of the outer body comprises a nose seal arrangement.
111. The plug of claim 110 wherein the nose-seal arrangement comprises a latch-down mechanism.
112. The plug of claim 101 wherein the outer body and the inner mandrel are non-metallic.
113. The plug of claim 101 wherein the inner mandrel has an inner bore, and wherein the inner bore comprises a unique receiving profile such that a releasing device having a matching unique key profile can lock within it.

114. The plug of claim 101 wherein the inner mandrel has an inner bore, and wherein the inner bore is configured to accept a latch-down mechanism on a releasing device.

115. The plug of claim 110 wherein the nose-seal arrangement comprises a unique key profile.

116. A baffle adapter, comprising an inner bore designed to engage and seal against the outer body of a plug.

117. The baffle adapter of claim 116 wherein the inner bore is tapered.

118. The baffle adapter of claim 116 wherein the baffle adapter comprises a perforated catcher tube.

119. The baffle adapter of claim 116 wherein the inner bore has an inner diameter, and wherein the inner diameter is in the range of from about 70% to about 90% of the inner diameter of a casing string into which the baffle adapter may be placed.

120. The baffle adapter of claim 116 further comprising an extended length insert.